Effect of co-firing high percentages of secondary fuels on SCR deactivation

KEMA, the Netherlands

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KEMA POWER GENERATION & SUSTAINABLES

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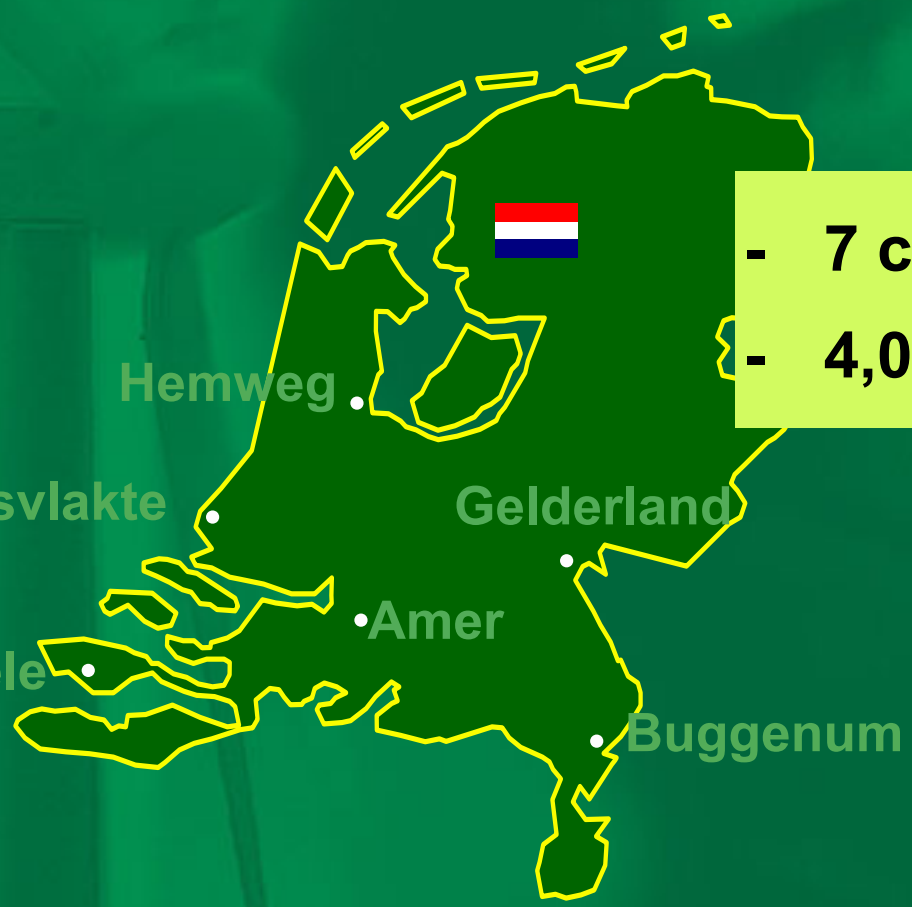
Introduction

- Why research ?
  - Dutch situation: SCR and co-firing
- Research project
  - deactivation SCR by in-duct exposure
  - assessment deactivation by calculation
- Perspective

SCR and co-firing in the Netherlands



- 7 coal-fired power plants
- 4,000 MWatt

SCR and

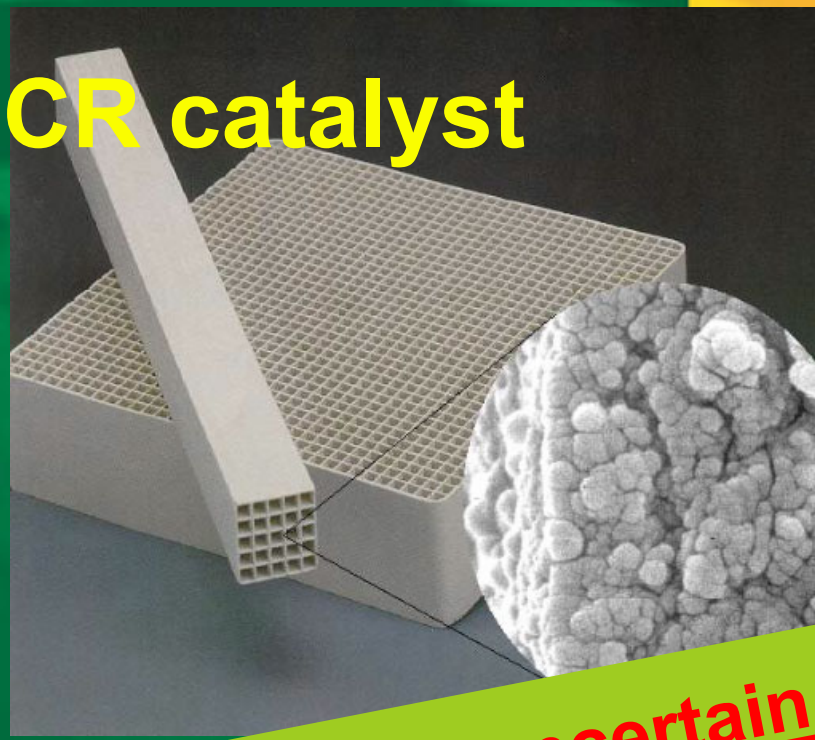
- in 2010 5% of Dutch electricity has to be generated with the use of SF
- replacement of 12% (e/e) fossil fuels
- requiring 4 Mton of SF per year

- Coal covenant Government with Power Companies: CO_2-reduction by replacement of coal by secondary fuels (SF)

- Changes in emission legislation:
  - Stricter emission limits (200 mg/m_0^3 NO_x)
  - NO_x emission trading (start 2005)

NO_x-reduction with SCR is inevitable !

Effect of co-firing SF on SCR catalyst



the impact of co-firing large amounts of SF is still uncertain

Need for research:

By order of Dutch Power Generation Companies

- E.ON Benelux Generation
- Electrabel Nederland
- Essent Energy Production
- Reliant Energy Power Generation Benelux

- co-funded by Novem (the Netherlands Agency for Energy and the Environment)

Project outline

Aim:

Assess the effect of co-firing SF
conditions)

meat and bone meal (MBM)
refuse derived fuel (RDF)
waste wood
sewage sludge
poultry litter
more …?

- samples of SCR cata flue gas during 1.5 year
- exposure at co-firing conditions (up to 20% mass)
- 4 catalyst manufacturers (confidential)
- determine activity changes, deposits on surface
- calculations (flue gas composition, economics co-firing on SCR

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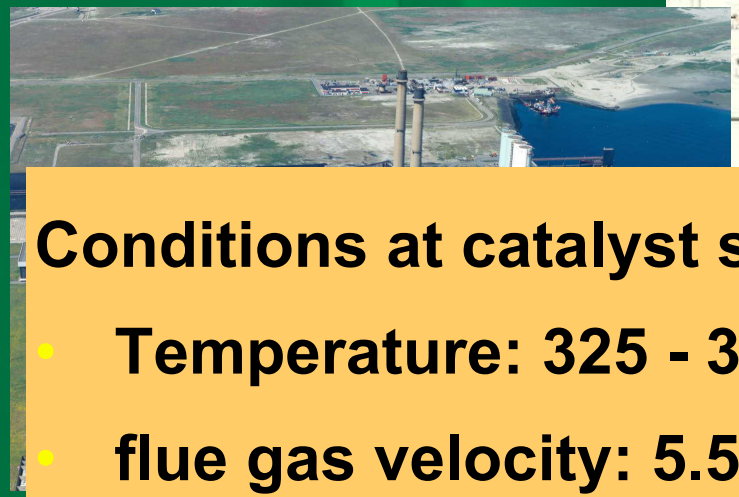
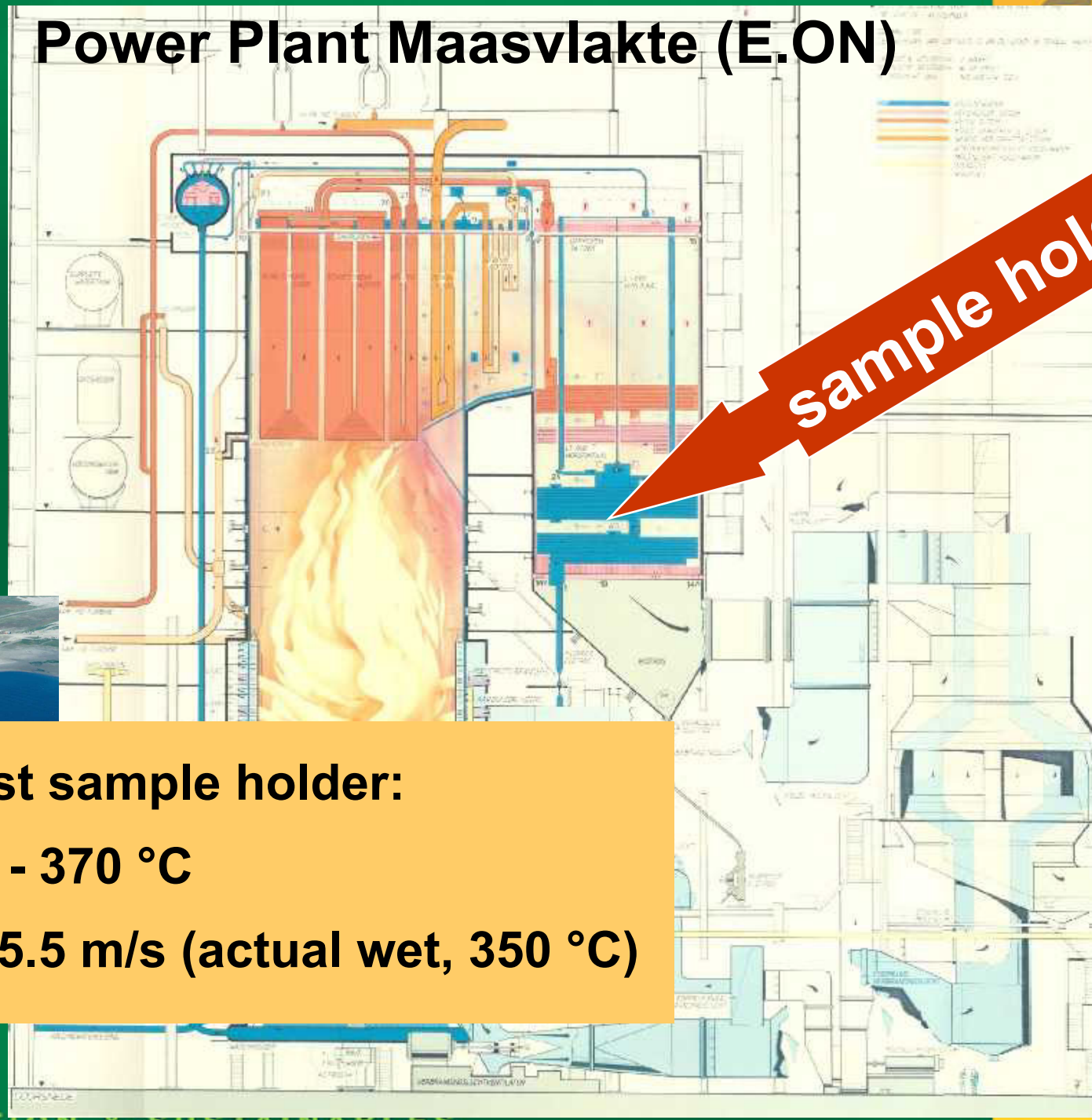
Position sample holder

Power Plant Maasvlakte (E.ON)

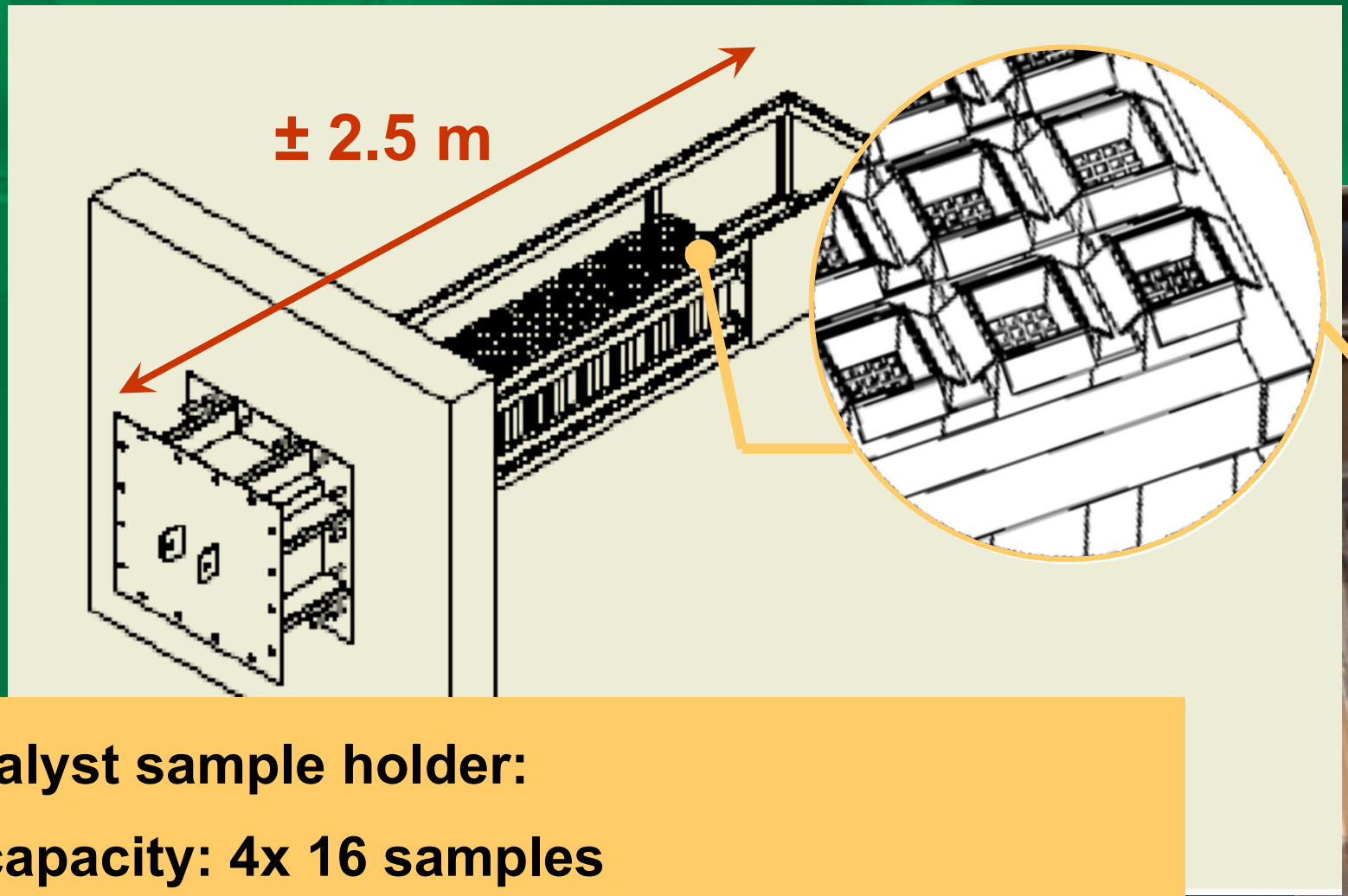




Conditions at catalyst sample holder:

- **Temperature: 325 - 370 °C**
- **flue gas velocity: 5.5 m/s (actual wet, 350 °C)**

Design sample holder



Catalyst sample holder:

- **capacity: 4x 16 samples**
- **catalyst samples: 35x35x250 mm**

Assess deactivation by calculation

Can we assess the risk of deactivation by calculating the flue gas composition at the position of the SCR ?

- calculation with software tool FactSage™
- comparison of situation with and without co-firing
- 4 different fuels: waste wood, RDF, poultry litter, MBM at 12,5 and 25% co-firing (e/e)
- find correlations between theory and practice

Calculation of flue gas composition

Short outline calculation with FactSage :

1. macro composition flue gas (1,400 °C, 3% O_2)
2. equilibrium calculations for temperature path: 1,400 - 200 °C

- calculations for a power plant of 1,500 $MW_{thermal}$
- assumption: solids, once formed, are inert

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Evaluatio

Poison content SF compared to coal

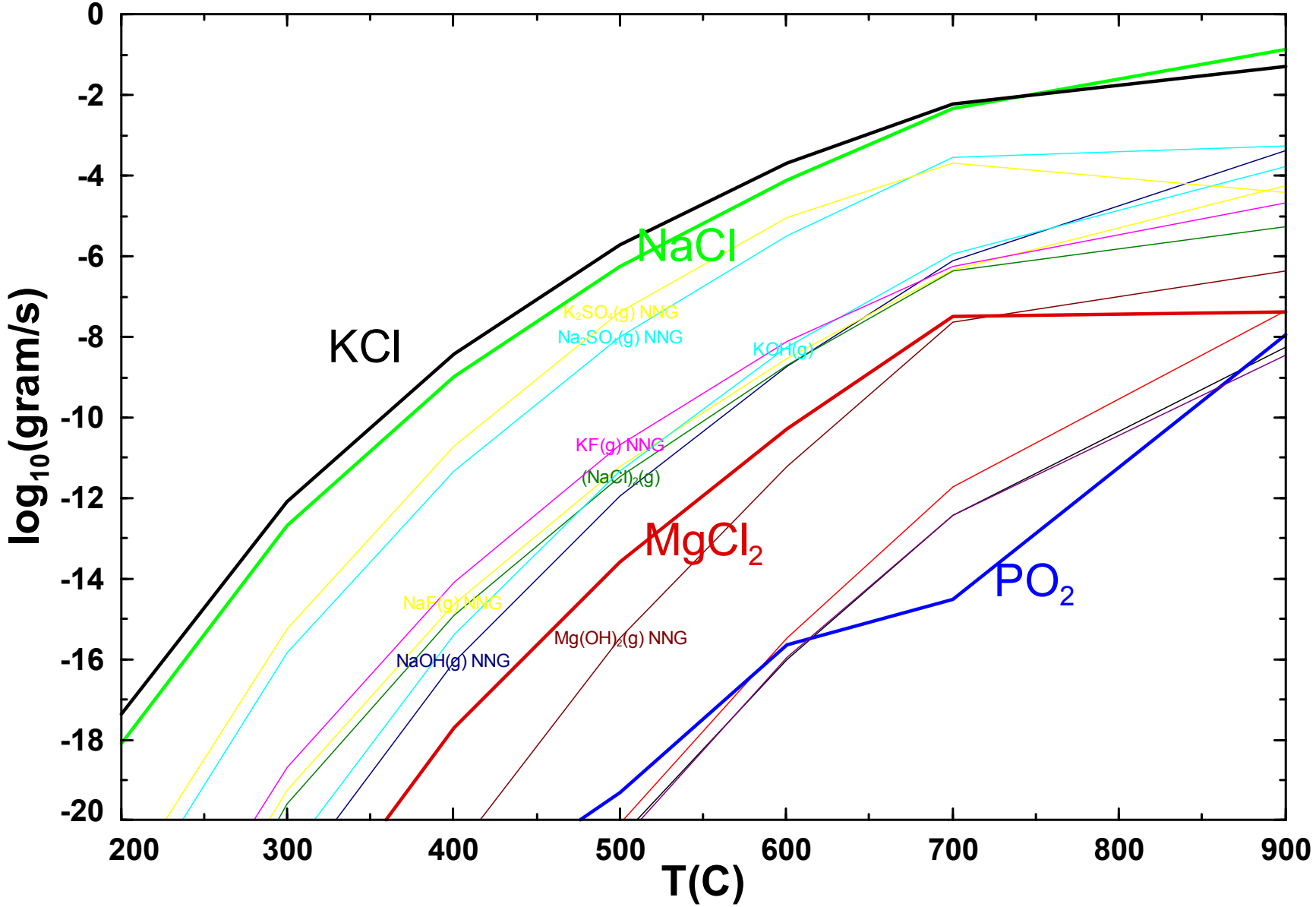
	RDF	MBM	Poultry L	Waste W
K		5x	12x	
Na	6x	18x		
Mg				
P		82x	25x	
As				
Pb	20x			128x
Zn	13x	6x	18x	53x
Ca	7x	19x	12x	
Cl	15x	17x	10x	

Focus on pote

- Alkali and e
- Phosphorus
- Arsenic (As
- Heavy meta

Is there any change compared to firing pure coal ?

Results flue gas calculations



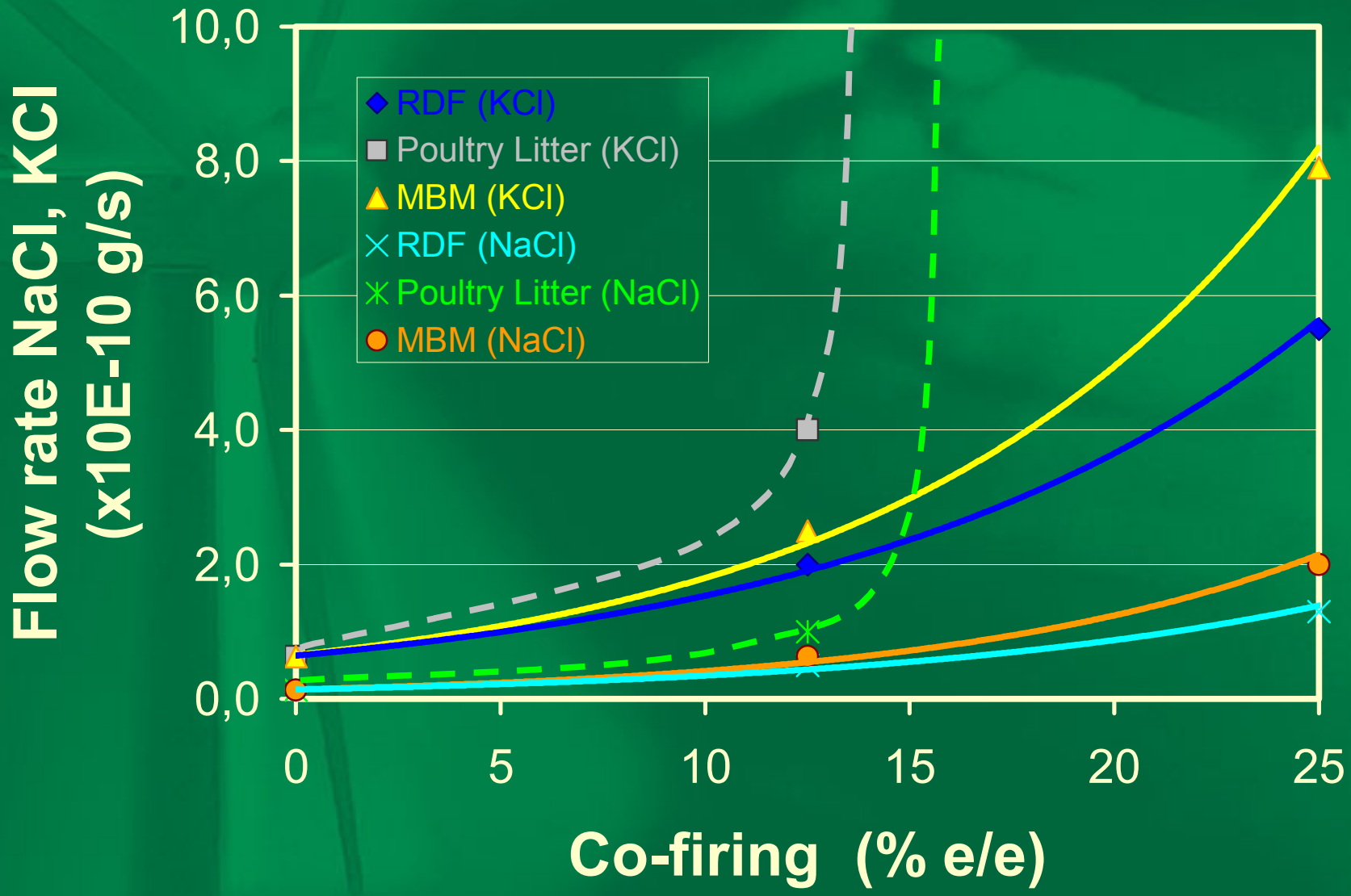
Coal, flue gas 900 °C, gaseous species on cooling

Summary flue gas calculations

The effect of co-firing on flue gas composition (350 °C):

- **MBM & Poultry Litter**: no phosphor increase in gas phase
- **MBM, RDF & Poultry Litter**: clear increase of sodium and potassium in gas phase

Summary calculations NaCl and KCl



Summary flue gas calculations

The effect of co-firing on flue gas composition (350 °C):

- **MBM & Poultry Litter**: no phosphor increase in gas phase
- **MBM, RDF & Poultry Litter**: clear increase of sodium and potassium in gas phase
- **demolition wood**: no Pb and Zn increase in gas phase but Pb-enrichment outer surface fly ash can be expected
- **In general**: no changes in Arsenic behavior

- Indications of risks can be given
- results from practice are necessary

Perspective Project

- Unique information about SCR catalyst deactivation
  - from long term exposure
  - at realistic conditions in a real power plant
  - exposed when co-firing high percentages of SF

- Results can immediately be used and contribute to a more reliable and cost effective SCR process operation

Perspective Project (2)

- Assess the risk of deactivation by calculation the flue gas composition is promising, next step is practical validation

- Project results are essential for a reliable cost evaluation
  - will be used in our SCR predictive tool

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Thank you for your attention and ...

see you soon for the latest results !

Feel free to contact us !

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